Parametric instability of a broad-band Alfvén wave: nonlinear evolution and saturation.

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The nonlinear evolution of the parametric instability of a finite amplitude Alfvén wave is studied in a one-dimensional geometry. The linear stage of this instability had been examined by Malara and Velli, (Phys. Plasmas **3**, 4427 (1996)), who showed that even a nonmonochromatic broad-band wave is unstable. Here, the time evolution is followed up to saturation, by numerically integrating the full set of MHD equations. Several configurations of the Alfvénic pump wave, as well as different values of the plasma β are examined. The saturation level of the instability does not depend on the spectral width of the pump wave, but it depends on the value of β. For $\beta \leq 0.5$ the final state is characterized by a cross-helicity ~ 0 and a moderate level of density fluctuations: the Alfvénic correlation of the initial wave is completely destroyed, even for a broad-band initial spectrum. For $\beta = 1$ the final cross-helicity is closer to that of the initial wave, indicating a lower saturation level. The parametric process appears to be nonlocal in the wavevector space also in the nonmonochromatic case, this feature becoming more relevant with increasing β. These results are relevant to the problem of the cross-helicity decay observed in solar wind at high latitudes.

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